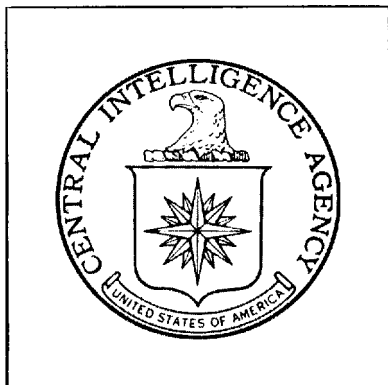


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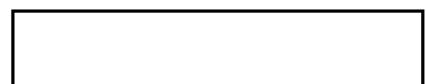
# *Imagery Analysis Report*

Analysis of Construction

Stages of Soviet III-D ICBM Sites

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## ANALYSIS OF CONSTRUCTION STAGES

## SOVIET III-D ICBM SITES

## SUMMARY

Beginning in mid-1966, there has been a substantial slowdown in the Type III-D single silo deployment program which continues through mid-1967. During this time the Soviets may have also encountered minor construction problems as indicated by the re-excavation of some silos; however, evidence of widespread re-excavation has not been observed.

In addition, the abandonment of L-shaped interferometers at some control sites and the apparent intention of not building them at others suggests a modification in the guidance system.

It appears that improved construction techniques have permitted the Soviets to complete Type III-D sites in 12-14 months rather than the previously assessed 14-16 months or more, thus necessitating changes in construction timing and techniques in the site construction stages.

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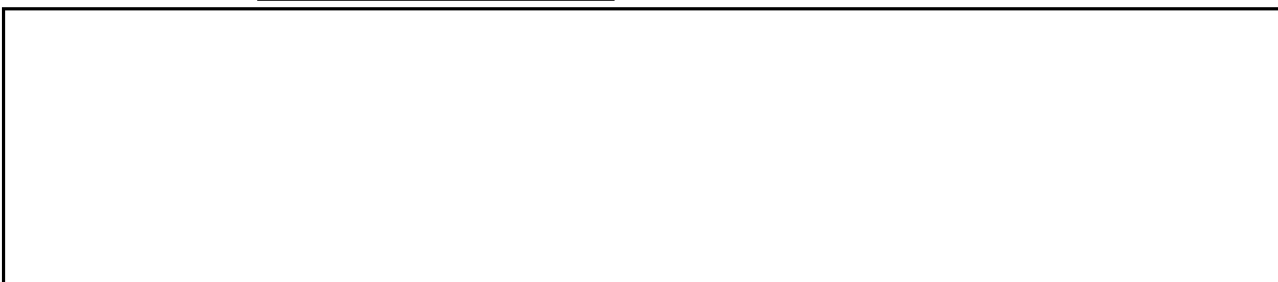
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## INTRODUCTION

A total of nine ICBM complexes with Type III-D single silo launch sites in various stages of construction have been identified in the USSR. These sites are located at the Drovyanaya, Gladkaya, Kostroma, Olovyanaya, Perm, Yedrovo, Kozelsk, Svobodnyy, and Tatishchevo ICBM Complexes (Figure 1).

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The purpose of this report is to update CIA report CIA/PIR-61089 [redacted] by providing additional information concerning the stages of construction at these sites as revealed by large-scale photographic coverage and to fill in the gaps concerning construction techniques. It is intended to provide a better understanding of the Type III-D single silo construction sequences and present significant developments concerning construction timing of the Type III-D ICBM sites. Included are changes in methods of construction and in the duration of the various stages in the light of more recent analysis. Figure 2 shows the changes in construction timing at these sites as a result of this analysis.

A photographic chronology depicting the major activity during each construction stage is also included. All measurements have been made by CIA/IAS. The construction stages were developed jointly by CIA/IAS and CIA/OSR analysts.

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The cut off date for information contained herein [redacted]

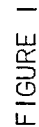
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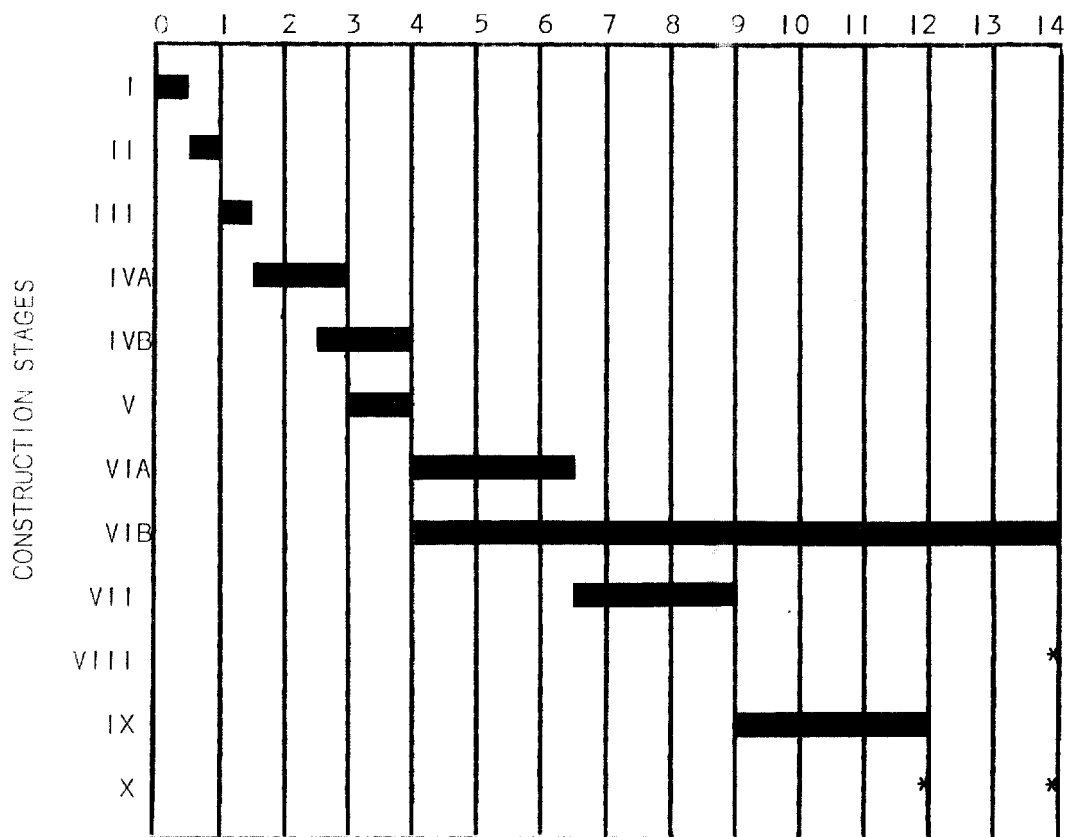
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## CONSTRUCTION TIMING, SOVIET TYPE II D ICBM SITES

TIME IN MONTHS



## DESCRIPTION OF CONSTRUCTION STAGES

- I CLEARING AND GRADING
- II OPEN CUT EXCAVATION
- III CORING VISIBLE
- IVA SILO HEADWORKS UNDER CONSTRUCTION
- IVB CLEARING AND EXCAVATION FOR CONTROL/GUIDANCE
- V SILO COMPLETE TO SURFACE LEVEL
- VIA INSTALLATION OF RAILS--LEVEL ACCESS ROAD PATTERN NOT WELL DEFINED
- VIB CONTROL/GUIDANCE UNDER CONSTRUCTION
- VII LEVEL ACCESS ROAD PATTERN WELL DEFINED
- VIII CONTROL/GUIDANCE COMPLETED
- IX LEVEL ACCESS ROAD COMPLETE. SURFACING OF ROAD AND INSTALLATION OF SILO DOOR
- X SITE COMPLETE

FIGURE 2

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## DISCUSSION

Deployment

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Deployment of the Type III-D single silos first occurred [redacted] at Drovyanaya, Gladkaya, Olovyanaya, Perm, and Tatishchevo. Svobodnyy and Kozelsk probably started deployment [redacted] with Kostroma and Yedrovo beginning the first quarter [redacted]

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Photographic evidence indicates the impetus of the Type III-D ICBM deployment program has substantially diminished [redacted] Only four launch groups were started in the period [redacted] as compared with 16 launch groups begun the preceding six months. Four additional launch groups were started during the first four months [redacted] indicating that deployment is still continuing but at a slower pace. There is a possibility, however, that several launch groups may have started during early 1967 that still remain undetected.

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To date, 51 Type III-D launch groups have been identified, each group consisting of ten launch sites including a control site. These, in addition to a site referred to as the complex command control center at each of the nine rail-to-road transfer points, give a minimum potential of 519 launch sites of which 498 are confirmed or probable.

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Tatishchevo, with 111 launch sites at 11 groups, is the largest of Type III-D complexes. Sixty-two silos were deployed here [redacted] This is 60 percent of the total of single silo launch sites begun the previous year [redacted] at all Type III-D ICBM complexes. Olovyanaya is the second largest complex, with eight confirmed and one probable launch group. Rapid deployment was also evident at Svobodnyy [redacted] Construction started here [redacted] and five launch groups were detected in [redacted] The first four launch groups at Svobodnyy began within eight months of initial deployment and had no precedent at any other complex in the previous two years of Type III-D deployment.

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Deployment of the Kostroma Type III-D Launch Sites was initiated almost simultaneously with Svobodnyy, but only three launch groups have been observed here to date.

Construction Timing Anomalies

It appears that construction of deployed Type III-D launch sites now approximate the pace observed at Launch Group 'L' at Tyuratam Missile Test Center, where sites were completed in a period of 12 to 14 months. There

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are exceptions, however, as a pause was detected at Olovyannaya Launch Groups 'I' and 'K' and six launch groups at other complexes. At Olovyannaya 'K' group, launch sites were five to seven months behind a normal construction cycle [REDACTED] This was apparently due to an actual stop in construction on the silo headworks [REDACTED]

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[REDACTED] For example, Olovyannaya Launch Site K-4 had the same section missing from the silo headworks from [REDACTED]

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[REDACTED] The launch site remained in Stage IV-A for over five months, compared to an average of one and one-half months, and was under construction more than ten months, thereby falling seven months behind schedule [REDACTED]

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In contrast, an accelerated construction rate was detected at Tatishchevo Site 10 [REDACTED] where the silo headworks were completed (Stage V) to surface level in less than 38 days--almost two months ahead of schedule. Since then, however, the construction rate at this site has returned to normal and was in Stage VII when last evaluated [REDACTED] At some complexes, site completions have been observed in as little as 11 months.

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Normally, there is a five to six month differential in the starting date for the initial and last site begun within a launch group. Therefore, since all sites within a launch group are not completed simultaneously, it may take 18 to 20 months to complete a group.

#### Construction Problems

A unique situation was observed at Gladkaya in [REDACTED] when four completed sites within the original group (F) were re-excavated around the silo headworks. These launch sites were later recompleted. The purpose of this re-excavating was never determined, and no evidence exists of similar activity at other Type III-D complexes.

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Only one Type III-D launch site has been abandoned (Tatishchevo Launch Site 105) since the initiation of the Type III-D program over three years ago [REDACTED] This site was relatively far advanced in construction at the time and the reason for its abandonment has not been ascertained.

\* Poor photographic coverage [REDACTED] has prevented further analysis of this launch site.

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Control/Guidance

Only two Type III-D complexes--Tatishchevo and Olovyannaya--have L-shaped interferometers associated with their control sites. In fact, only seven of the 20 control sites at these two complexes presently contain L-shaped interferometers. At least one additional control site at Olovyannaya (K-1) has a security fence large enough to eventually contain an L-shaped interferometer. Another control site at Olovyannaya (I-1) initially had a security fence large enough for an L-shaped interferometer, but the fence line was repositioned and the legs of the L-shaped interferometer were never constructed. L-shaped interferometers were previously intended for Yedrovo ICBM Complex but were abandoned while under construction. It is unlikely the control sites at Drovyanaya, Gladkaya, Kostroma, Kozelsk, Perm, and Svobodnyy will have associated L-shaped interferometers. It appears that all launch sites within a launch group will eventually be connected by cabling with their respective launch control site, and to date this is evident at 21 launch groups.

A complex command control center is under construction at all Type III-D complexes except Kostroma and Yedrovo, where they are eventually expected to be constructed. They are located in or adjacent to the rail-to-road transfer point and consist of a typical Type III-D site and a much larger than normal control bunker. Presently, only the complex command control center at Olovyannaya contains an associated L-shaped interferometer. It is expected that as each complex approaches its maximum launch group deployment, the complex command control center may tie together all the launch groups within the complex by cable interconnection. Currently, only Launch Groups 'E' and 'G' at Olovyannaya have been identified as being interconnected by cabling.

A hardened (subsurface) antenna has been observed collocated with several launch control sites at Tatishchevo (Figure 13). Normally, these antennas are associated with ICBM complex communication facilities, which are a separate entity from the launch control site.

Site Orientation

The orientation of the deployed sites is consistent within a complex, and in almost every case, consistent with the firing azimuth of the previously deployed SS-7 and SS-8 sites at the complex. At those control sites with associated L-shaped interferometers, the site orientation is parallel with that leg of the interferometer which is directed towards the United States.

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## CONSTRUCTION STAGES

(Foldout Construction Timing Chart on Page 30.)

Stage I - Clearing and Grading (Time in Stage - Zero to Two Weeks)

The time necessary for site preparation will vary between zero to two weeks, depending upon the type of terrain selected for the site. A maximum of two weeks is needed for clearing and grading in rugged or forested areas. A week or less is required in forested areas utilizing pre-existing clearings. Little, if any, preparation is required in open agricultural areas.

A well-defined road network leading to the sites is not generally constructed during this stage (Figure 3). An exception is the Svobodnyy ICBM Complex, where improved roads were constructed to the vicinity of several sites prior to Stage I. Positive identification of a launch site is impossible during this stage since the initial activity can easily be confused with logging or agriculture. The absence of a site support facility, which is normally built with Type III-C launch sites in this stage, further hinders detection of the site. Only in a few instances has the security fence been readily evident during this stage.

Approximately ten to twelve buildings are constructed, usually within a half mile of the eventual control site, prior to the start of construction on the launch group. These constitute the control site construction support facility and are dismantled after the control/guidance facilities are completed (Figure 8).



FIGURE 3

STAGE I

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Stage II - Open Cut Excavation (Time in Stage - Two Weeks)

In most instances, the silo excavation of a Type III-D launch site is minimal, consisting either of a shallow roughly circular hole, or a linear cut (Figure 4).<sup>\*</sup> The excavation appears to be made by a bulldozer and is usually only wide enough to accommodate the headworks. In the case of a linear cut, the orientation of the excavation is always perpendicular to the site orientation. Positive identification is difficult since the small excavation is normally distinguishable only on good quality photography, with proper contrast. Nevertheless, additional identifying features are evident under ideal photographic conditions which aid in detecting the launch site. These features include the security fence; track activity; scattered material/equipment; placing of the spoil pile beside the excavation thereby differentiating it from a borrow pit; and the proper spacing between known sites within the group.

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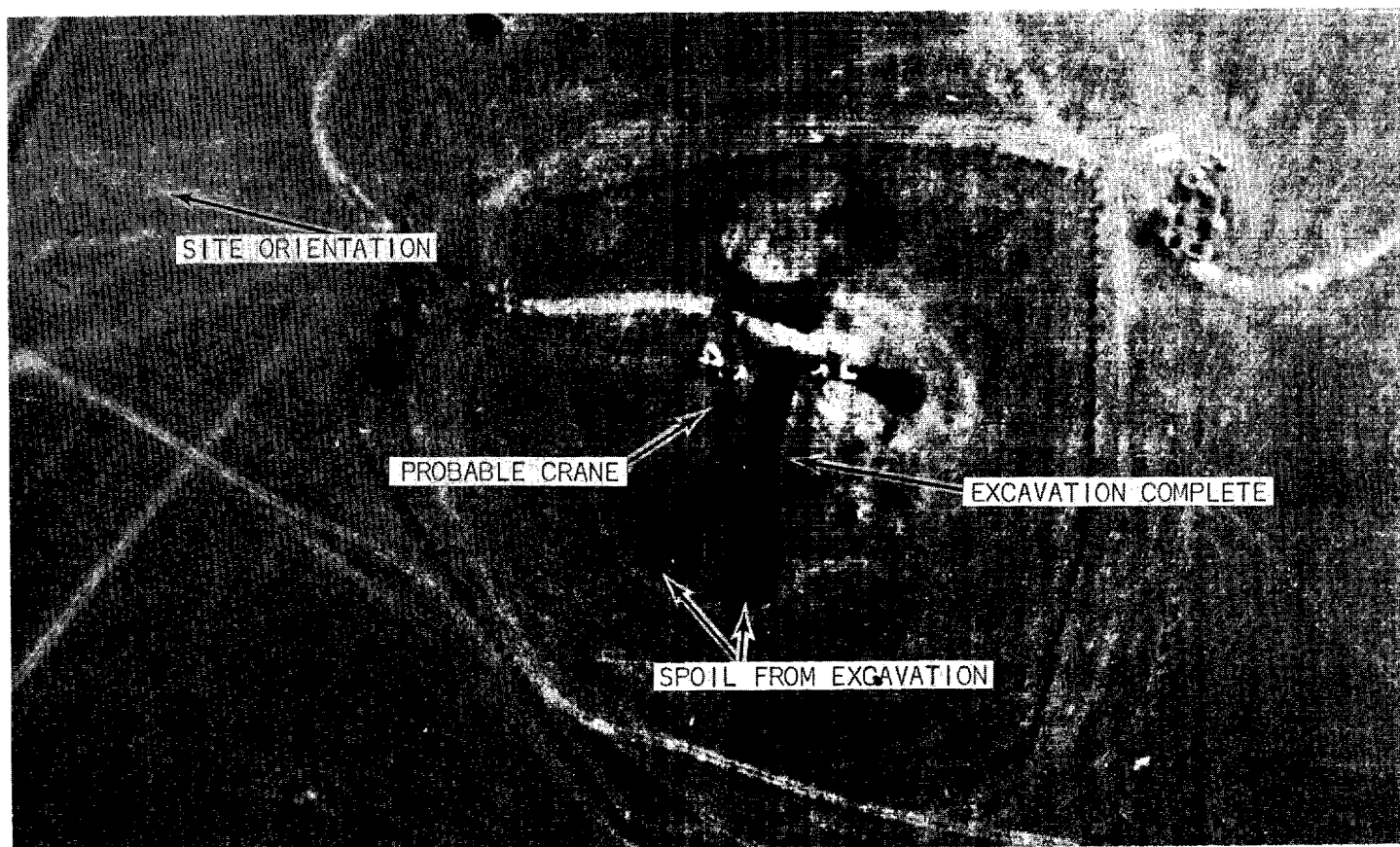


FIGURE 4

## STAGE II

\* In several instances the silo coring has been made directly from surface level, and this stage has been omitted entirely.

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Stage III - Coring Visible (Time in Stage - Two Weeks)

The silo coring is dug (Figure 5) directly from ground level or excavation level, and measures approximately [ ] feet in diameter. Spoil is extracted from the silo coring by a crane positioned adjacent to the excavation or coring and is usually piled next to the earth removed from the excavation (when present), forming a small, rectangular or tear-shaped mound near the excavation. Late in this stage, it appears that concrete is slip-formed to create a silo wall around the interior of the silo coring. Equipment and prefabricated segments for the eventual silo headworks are scattered around the site area. Again, this is rarely detectable on [ ] photography.

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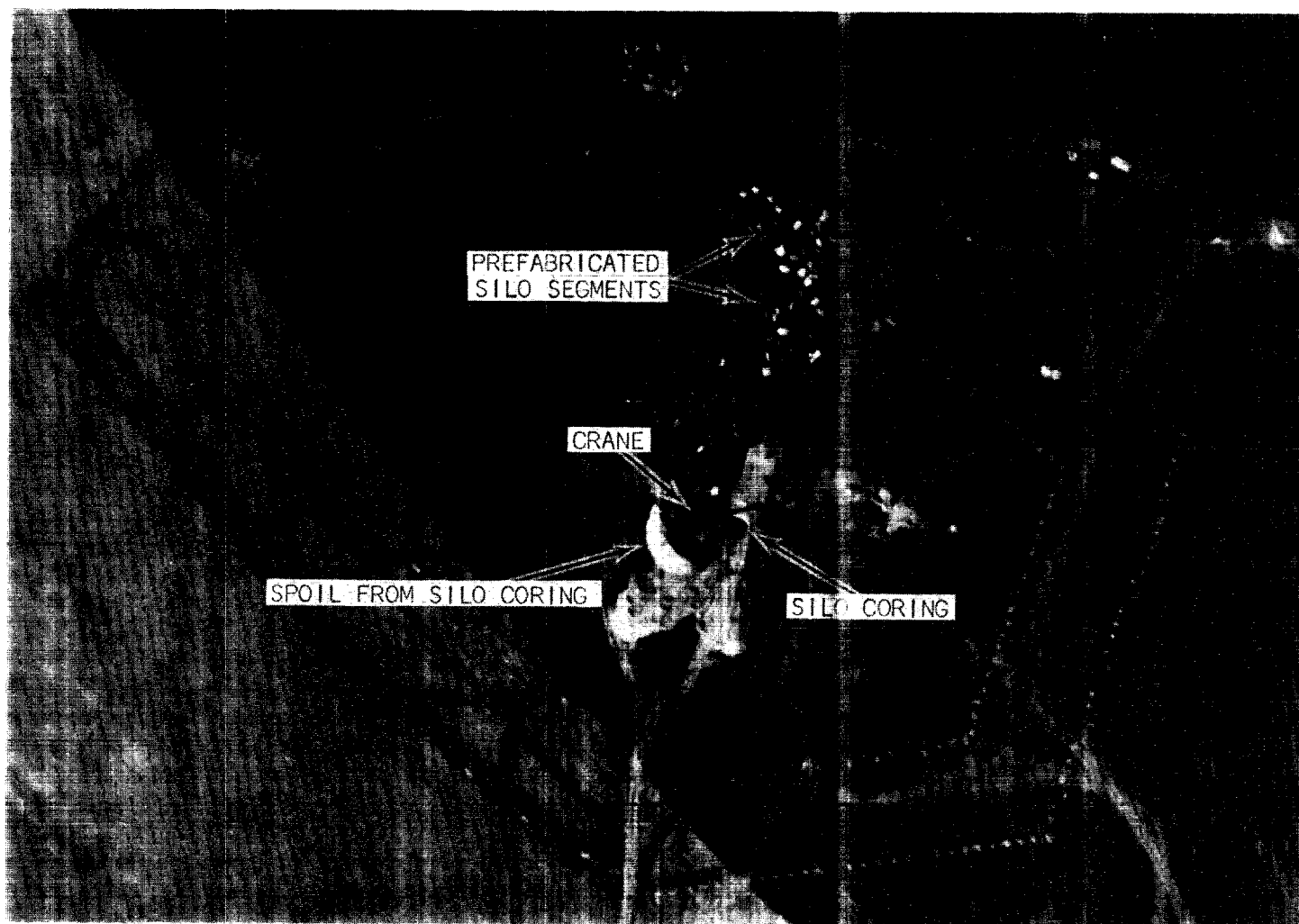


FIGURE 5

## STAGE III

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Stage IV-A - Silo Headworks Under Construction (Time in Stage - One and One-Half Months)

Except under ideal photographic conditions, which may permit identification of the launch site during previous construction stages, this stage is usually the earliest time the launch site can be confirmed.

Continuous good quality photography over Olovyanaya [ ] provided a better understanding of this construction technique.

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After the silo wall is constructed within the silo coring in Stage III, a circular steel liner is positioned over the silo coring upon a prefabricated foundation. The silo headworks, consisting of [ ] prefabricated segments, are then emplaced around the circular steel liner in two levels (Figure 6). These prefabricated segments taper from the inner to the outer sides, forming wedges which fit around the steel liner. As the silo headworks reach completion, the silo appendage (probable personnel entrance) is added.

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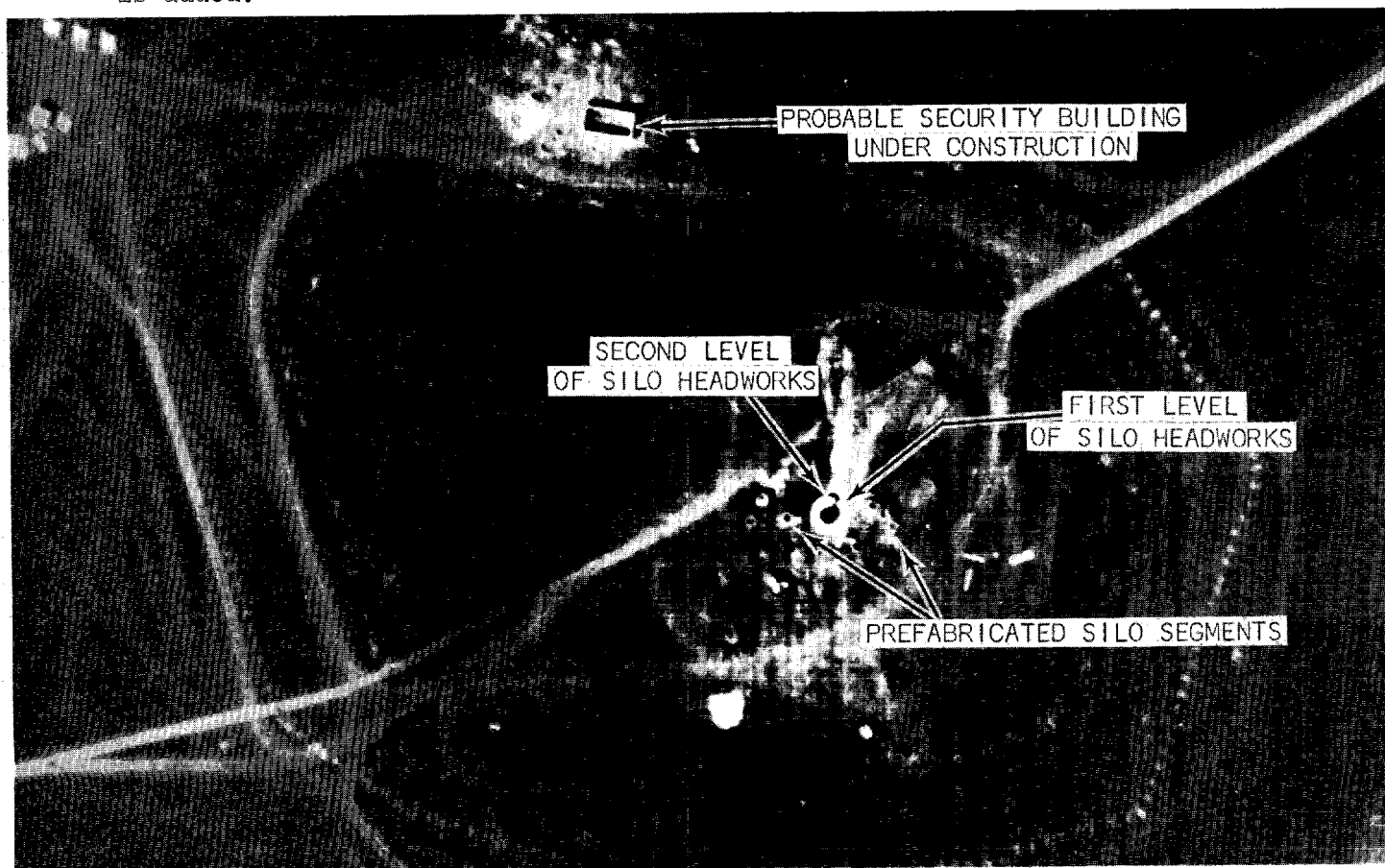


FIGURE 6

## STAGE IV A

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The last phase of this construction stage is depicted in Figure 7 where a prefabricated silo segment is missing, causing a wedge-shaped gap in the upper level of the almost completed silo headworks.

Numerous prefabricated silo segments for the silo headworks (square hollow objects) are frequently observed scattered in the vicinity of the silo.

Initial construction of a small probable security building at the site entrance normally becomes evident during this stage.

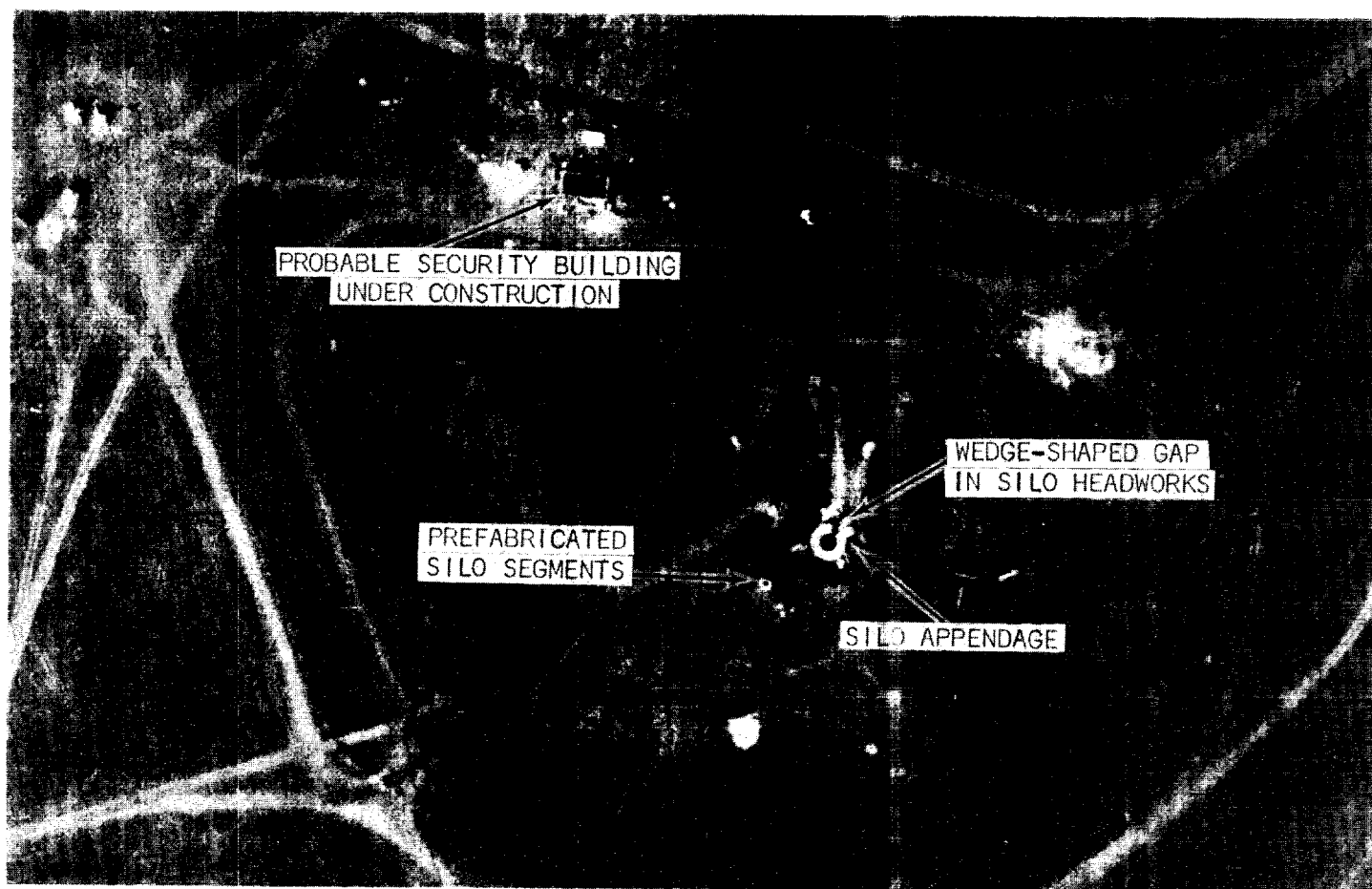


FIGURE 7

STAGE IV A

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Stage IV-B - Clearing and Excavating for Control/Guidance (Time in Stage - One and One-Half Months)

At any time in the construction cycle of the control site, which may be concurrent with the latter of Stage IV-A but generally about two and one-half months from its start, several excavations become evident. A rectangular excavation to contain the control bunker appears about 500 to 600 feet from the silo excavation (Figure 8). Adjacent to this excavation, a narrow linear foundation for an arch-roofed building is dug, and foundations for two large arch/flat roofed buildings appear near the outside of the security fence.

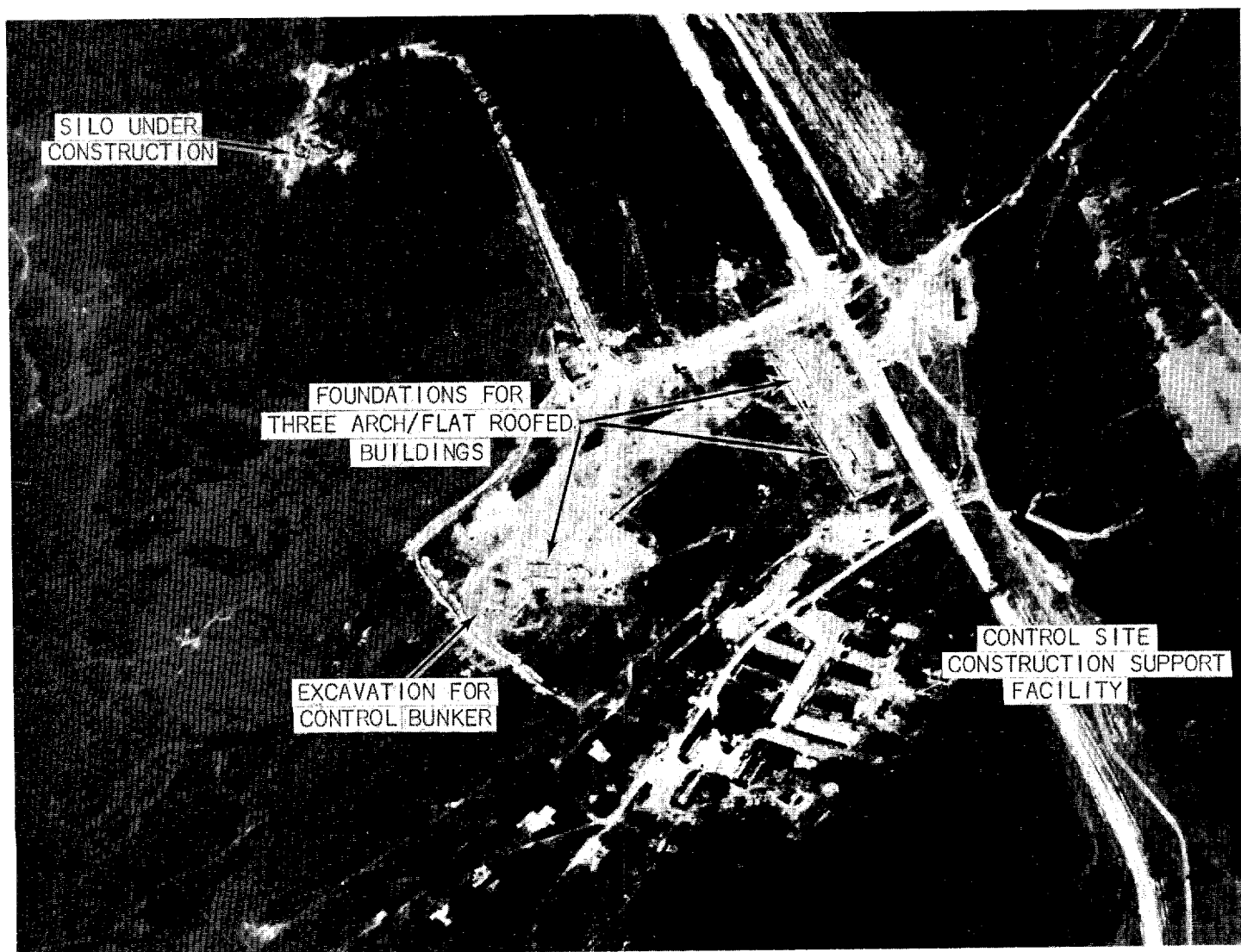


FIGURE 8

STAGE IV B

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Stage V - Silo Complete to Surface Level (Time in Stage - One Month)

The silo is complete to surface level upon the installation of the second level of wedge-shaped prefabricated silo segments and the silo appendage (Figure 9). The appendage breaks the circular shape of the headworks and provides access to the interior of the headworks and to the silo. The appendage is consistently installed 45 degrees counter-clockwise from the ultimate site orientation. Once the silo headworks are completed, little change is evident for a period of about a month except for backfilling of the silo excavation opposite the side from where the three rails for the silo door will eventually be installed.

Construction on the probable security building at the site entrance is generally completed near the end of this stage, although in several instances it is not completed until as late as Stage VII.

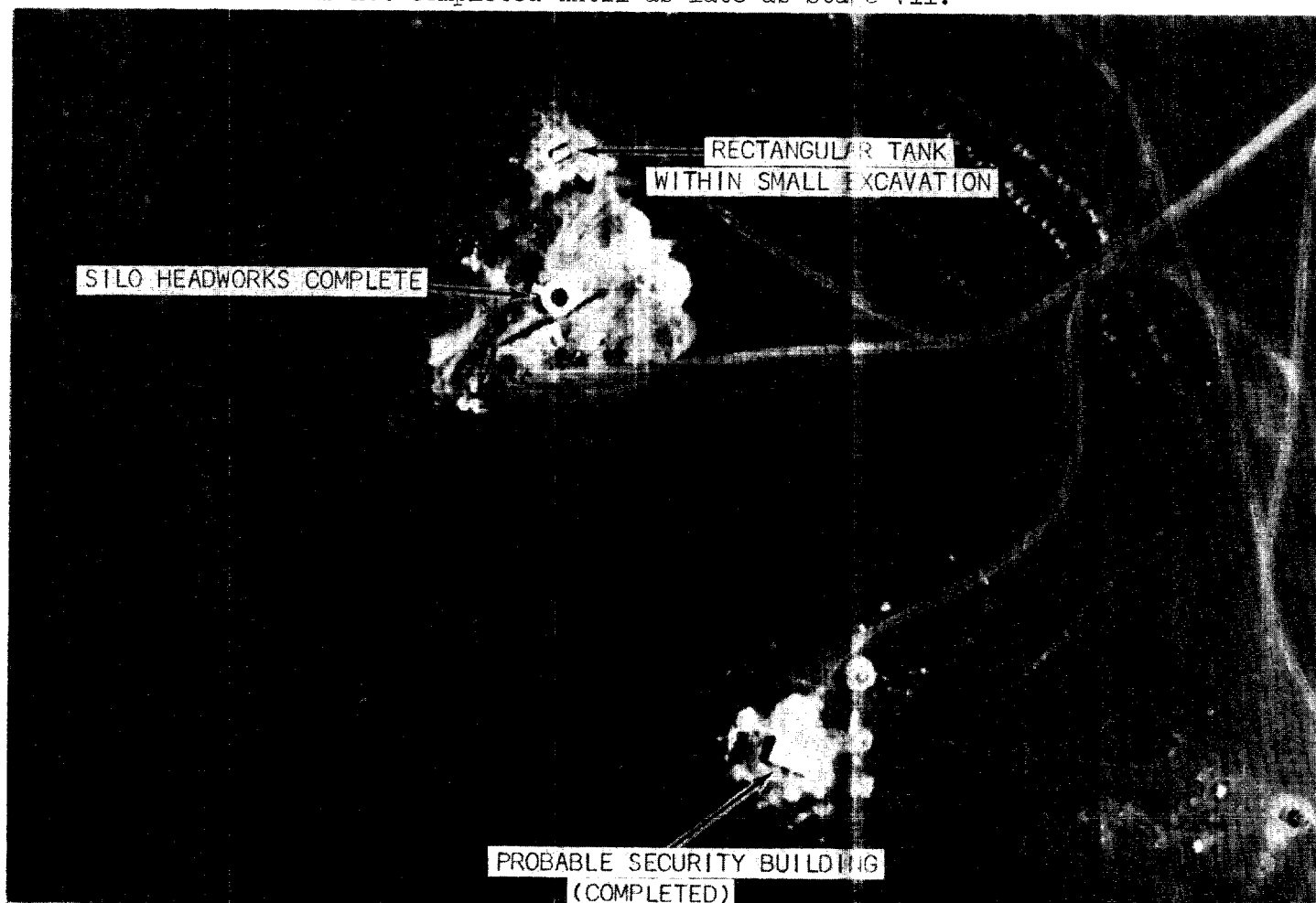


FIGURE 9

## STAGE V

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Stage VI-A - Installation of Rails, Level Access Road Pattern Not Well Defined (Time in Stage - Two and One-Half Months)

The beginning of Stage VI-A is marked by the construction of three rows of rail footings which extend outward from the silo headworks at an angle 90 degrees counter-clockwise to the orientation of the site (Figure 10). Usually, the three rails are completed in late Stage VI-A or early Stage VII, giving the appearance of three dark linear tracks. The rails remain unchanged until the silo door is installed in late Stage IX.

Normally during this stage, a small tank (15 by 10 feet) is installed within a shallow excavation about 100 feet from the silo on either side of the eventual level access road (Figure 10). Sometimes, this small tank appears in Stage V as seen in Figure 9.

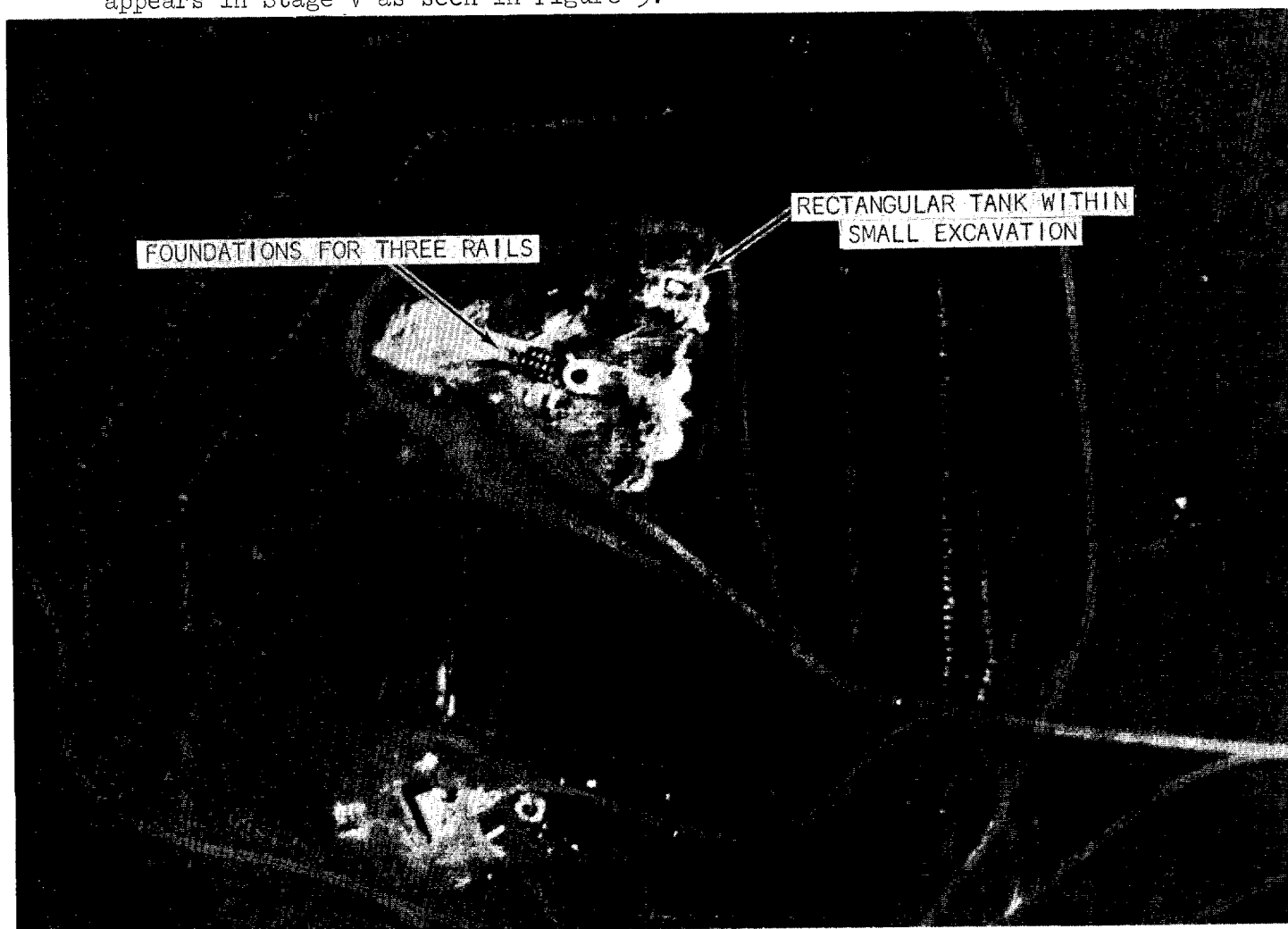


FIGURE 10

STAGE VI A

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Although the final site configuration does not become evident until later, the first indication of the site's general outline develops as a result of clearing and grading for the level access road (Figure 11). Near the end of this stage, cable ditching between the sites begins to appear.

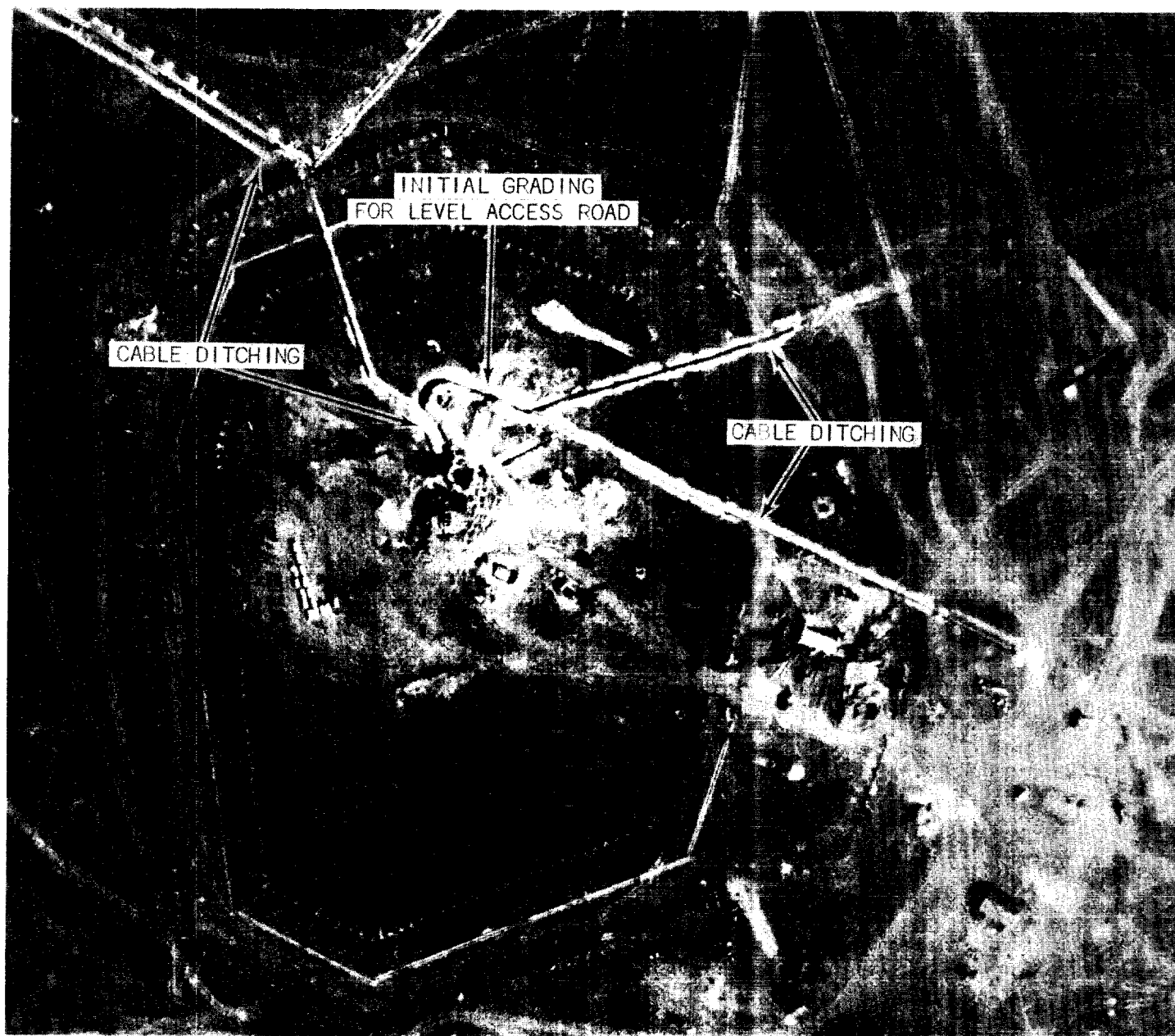


FIGURE 11

## STAGE VI A

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Stage VI-B - Control/Guidance Under Construction (Time in Stage - Ten Months)

This stage is initiated by construction commencing on the control bunker and an adjacent large arch-roofed building which is unique to the Type III-D system. Adjacent to the arch-roofed building are two excavations, one containing four small tanks, and the other containing two very small structures (Figure 12). The control bunker and adjacent arch-roofed building are connected by cabling to two large flat-roofed buildings constructed immediately outside the site security fence. Previously, these two large buildings were arch roofed except in several instances, where one of the two was flat roofed. At the latest deployed Type III-D launch groups, these buildings are now always flat roofed.

After construction of the control bunker is well advanced, ditching for the legs of the L-shaped interferometer appears and is identical to those at Type III-C control sites. The interferometer legs are 400 meters long (1,312 feet), and one leg is always oriented toward the expected direction of launch. Located along each leg at 50 meter intervals is a notch approximately [ ] square whose function is probably to support a wave guide antenna. Terminal antennas are placed within an excavation at the terminus of each leg, and an instrumentation building, located adjacent the control bunker, is constructed within an excavation at the vertex of the two legs. Figure 13 shows this stage near completion after nine to ten months of construction.

Not all the Type III-D control sites will contain L-shaped interferometers. Except for some control sites at Tatishchevo and Olovyannaya, no L-shaped interferometers will apparently be constructed at other Type III-D complexes. Those control sites without an L-shaped interferometer do not contain an instrumentation building, but have the other associated control/guidance facilities, including the control bunker.

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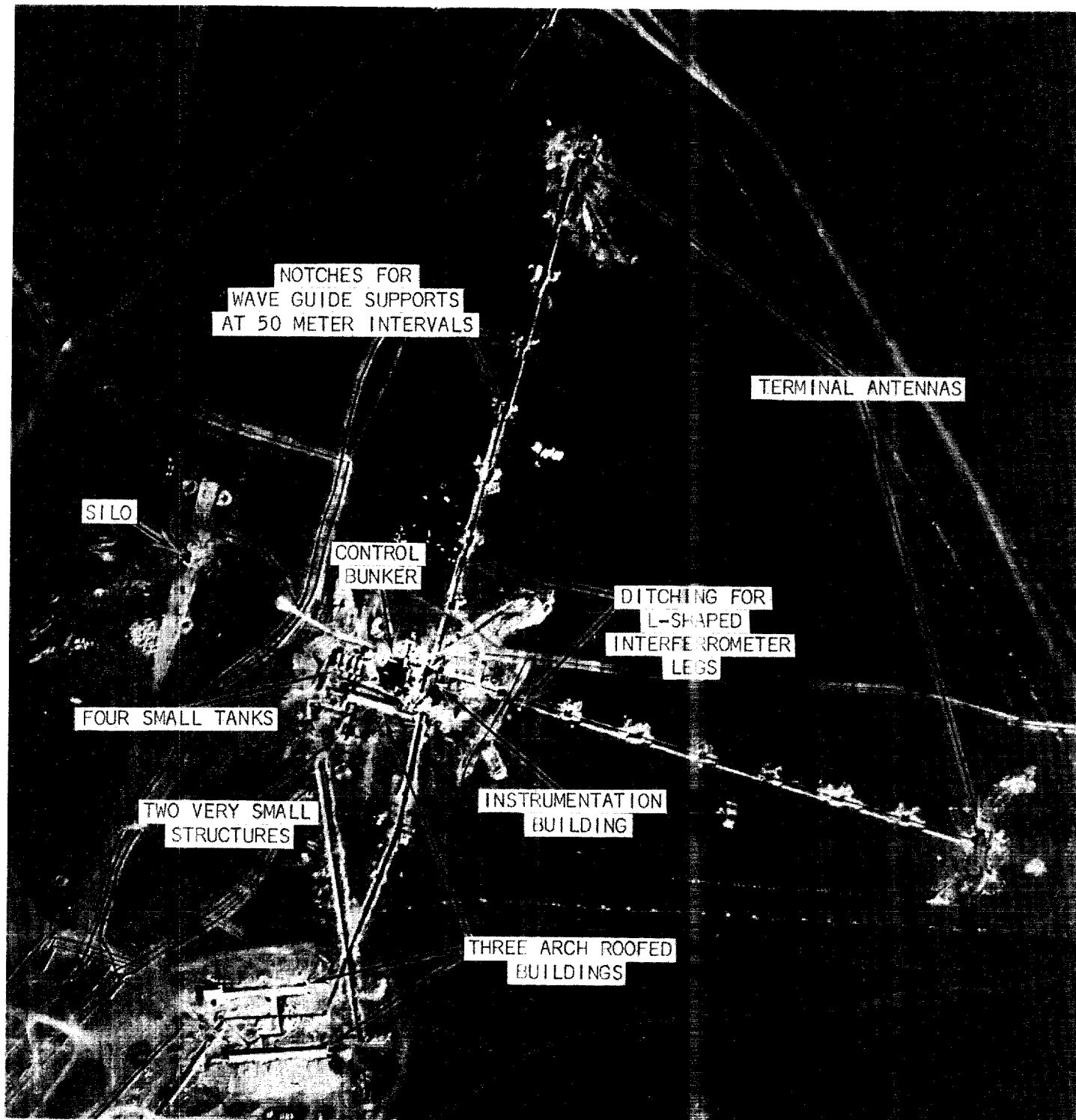


FIGURE 12

## STAGE VI B

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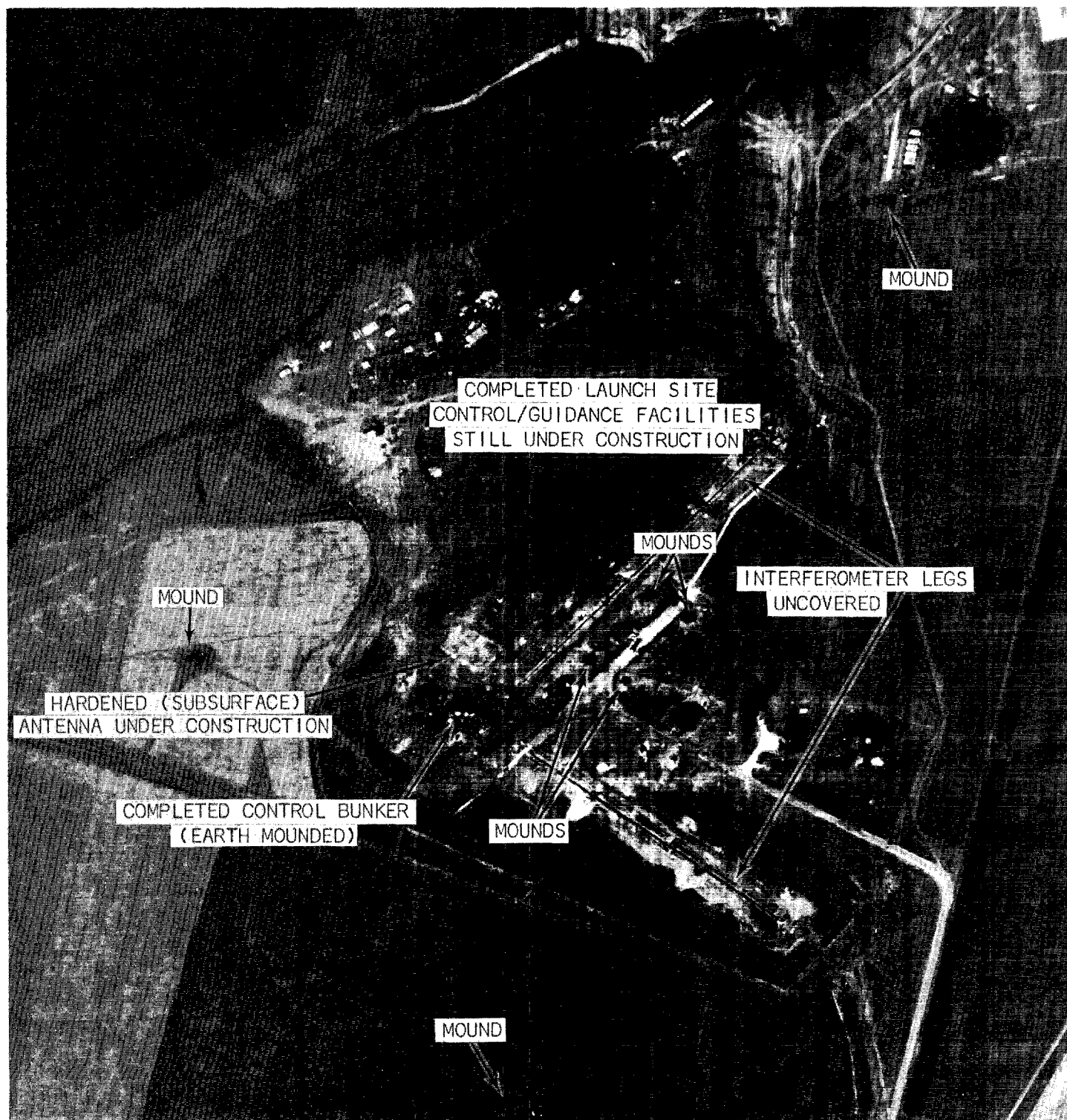


FIGURE 13

STAGE VI B

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Stage VII - Level Access Road Pattern Well-Defined (Time in Stage - Two and One-Half Months)

During this stage the level access road is gradually built up over two and one-half months and becomes well defined (Figure 14). The long axis of this road is consistent with the firing azimuth and site orientation. Construction continues within the silo headworks and frequently an environmental cover appears over the silo, particularly during the winter months. Sometimes a dark circular ring

25X1

25X1

appears near the headworks in both Stages VII and IX.

Usually late in this stage the rectangular tank within the small excavation about 100 feet from the silo headworks is earth mounded to the height of the level access road. The cables from the silo headworks to other sites in the group remain uncovered until Stage IX.

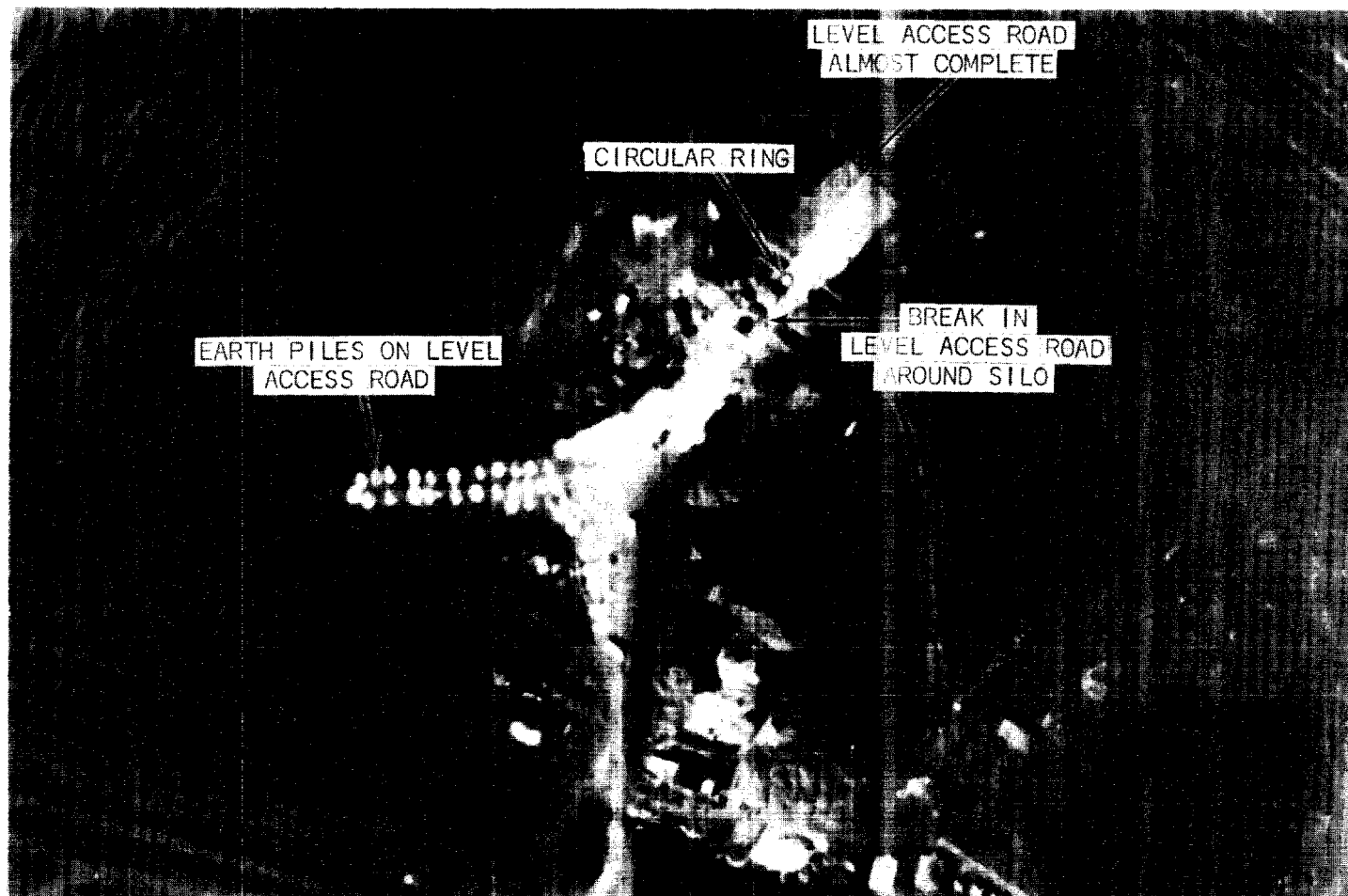


FIGURE 14

STAGE VII

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Stage VIII - Control/Guidance Complete

The control/guidance facilities are considered complete after all elements are backfilled or earth covered (Figure 15). The ten to twelve buildings composing the control site construction support facility are eventually removed after the control/guidance facilities are completed. Construction generally starts on the control/guidance facilities about four months after construction starts on the launch facilities and takes about ten months to complete thereby establishing a total elapsed time of 14 months.

Frequently, the control/guidance facilities continue under construction for several months after the launch silo is completed. This is not unusual since all launch sites within a group are not completed simultaneously, thereby allowing sufficient time to finish the control/guidance facilities at the control site prior to completion of the last remaining launch sites within a group.

Stage IX - Level Access Road Complete, Surfacing of Road and Installation of Silo Door (Time in Stage - Three Months)

The completion of the level access road marks the beginning of this stage except for an area of 110 feet on both sides of the silo headworks, which is paved last (Figure 16). An earthen silo door backstop is constructed at the terminus of the three rails very late in this stage. The silo door is installed with its top flush with the surface of the level access road. Generally, the silo door remains in an open position on the three rails while construction continues on the silo headworks interior. A dark circular ring appears on the level access road and sometimes is emplaced on a flat cover which obscures the interior of the silo. At this time the cable ditches radiating from the silo headworks are backfilled. At several complexes, four small excavations, each containing a small square cubicle, form a rectangular pattern around the launch silo. These cubicles are earth covered when the launch site is completed and are referred to as earth mounds (Figure 13). The precise function of these mounds is unknown. Some completed sites at Olovyannaya contain twin mounds positioned on opposite sides of the level access road. These are dimensionally smaller than those in the rectangular pattern, but in both cases, diagonals drawn through each mound bisect the silo.

An additional group of three widely spaced mounds (Figure 13) forming a triangular pattern outside the security fence is evident at some of the sites with the rectangular earth mound pattern. These three mounds first appear in Stage IX as excavations containing small square cubicles and are constructed in the same manner as the rectangular pattern earth mounds.

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Stage X - Site Complete

The final site configuration is usually readily identifiable by the following distinctive appearance: a T, Y, or L-shaped level access road; a silo door flush with the level access road; three rails on which the silo door slides; a silo door backstop at the terminus of the rails; a paved area of 110 feet on the level access road on each side of the silo headworks; a number of conical earth mounds adjacent to the level access road; protrusions from the level access road;\* an earth-mounded, arch-roofed building or an unmounded flat-roofed building near the security fence; and earth covered cables radiating from the silo (Figure 17).

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\* The earth-covered rectangular tank forms one of these protrusions.

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In addition, helicopter pads are becoming evident at many completed launch sites (Figure 18a).

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Figures 19

and 20 provide pertinent measurements on the III-D sites.

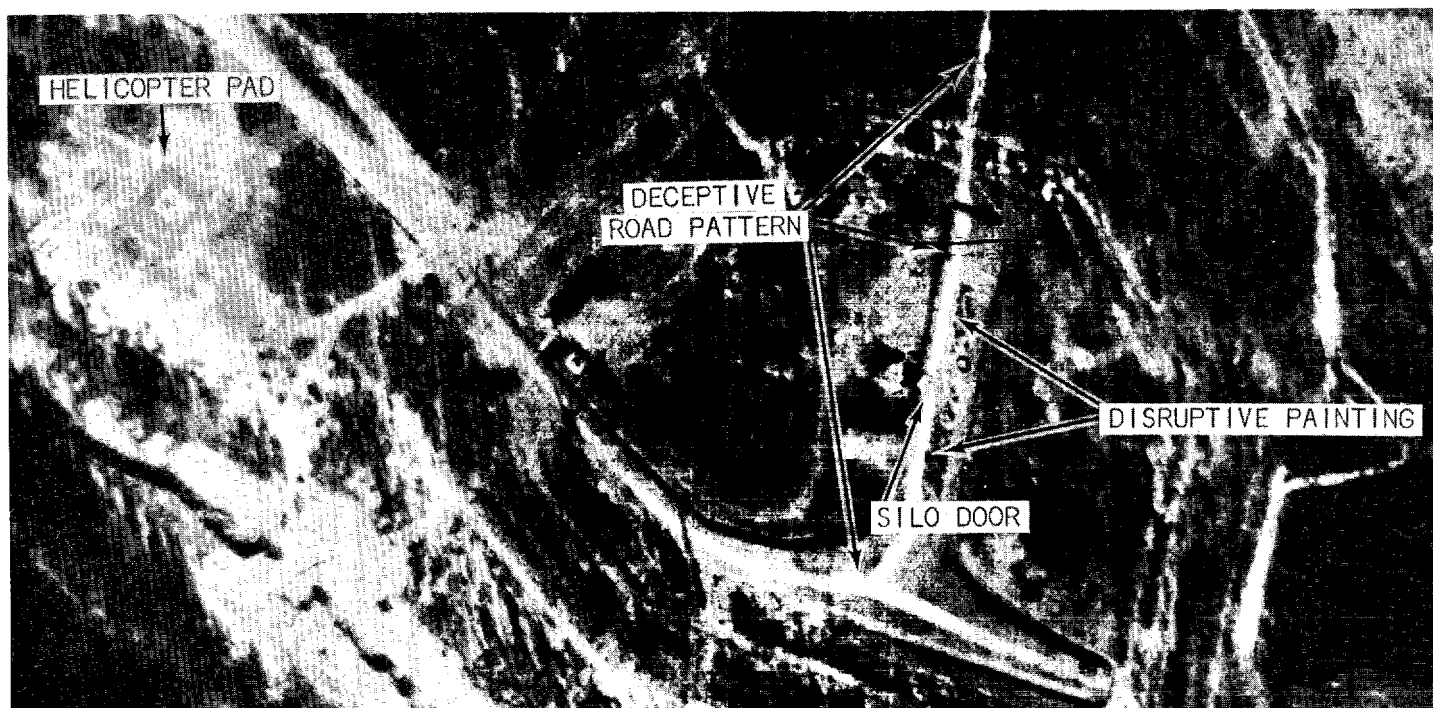


FIGURE 18a

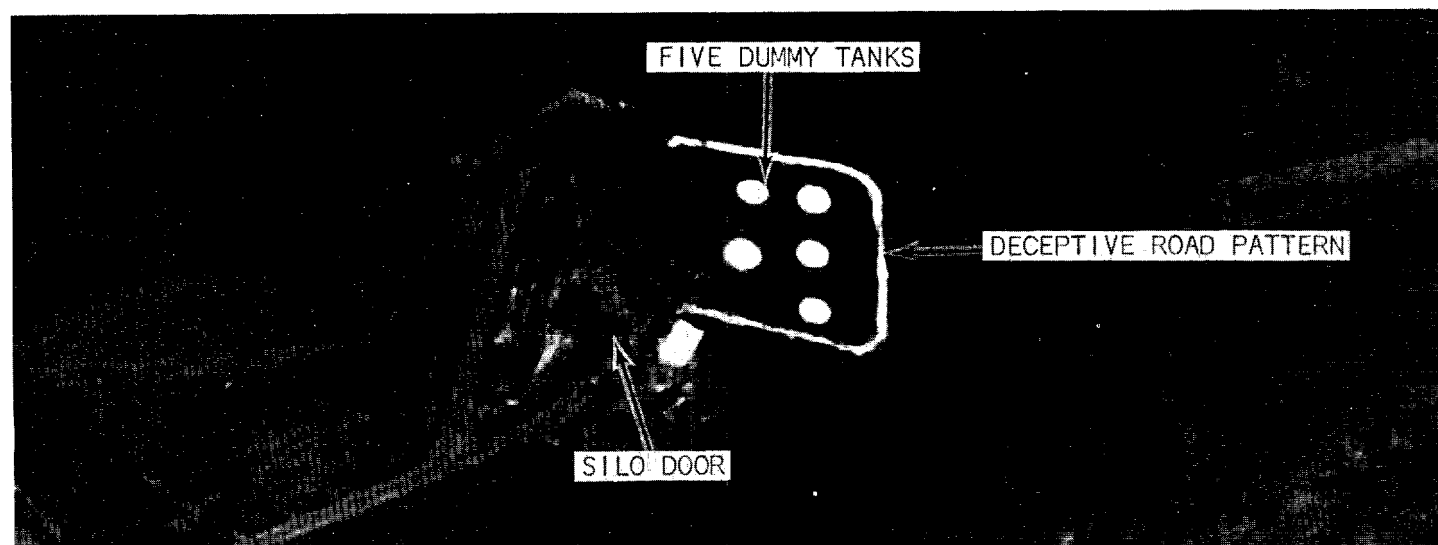


FIGURE 18b

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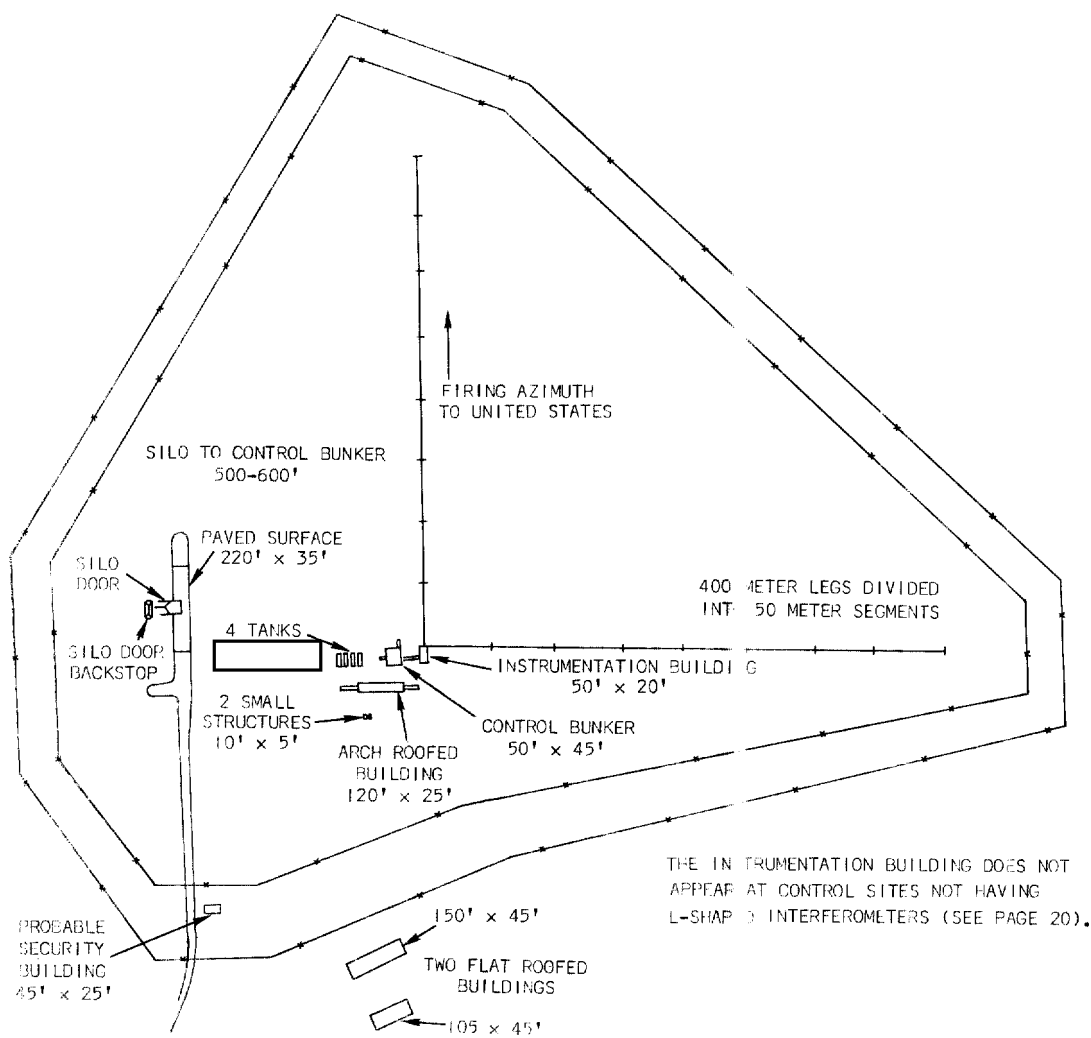


FIGURE 19

TYPICAL TYPE IIIC CONTROL SITE

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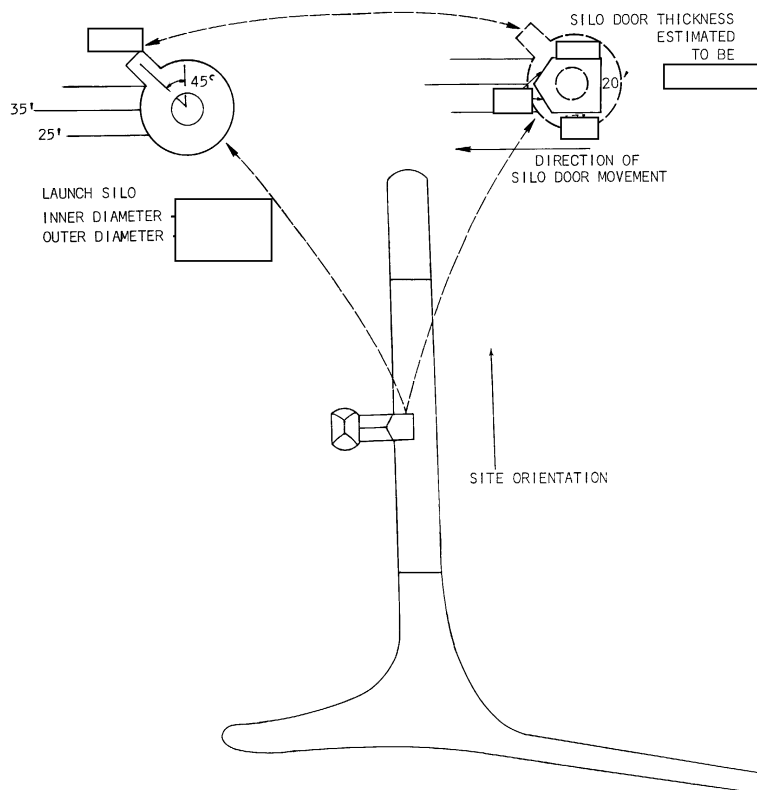
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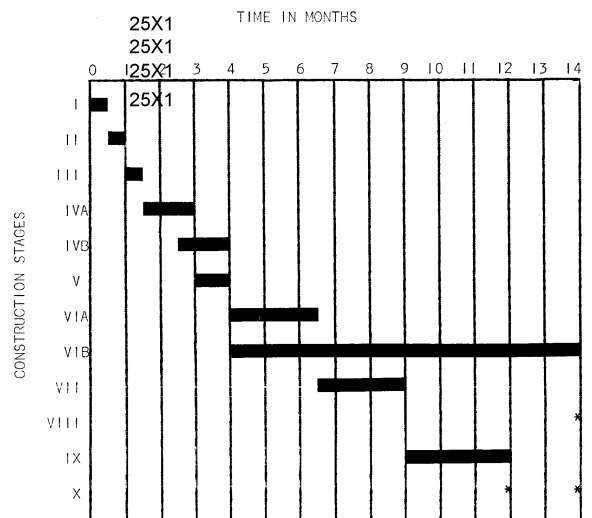
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CONSTRUCTION TIMING, SOVIET TYPE IIID ICBM SITES



DESCRIPTION OF CONSTRUCTION STAGES

- I CLEARING AND GRADING
- II OPEN CUT EXCAVATION
- III CORING VISIBLE
- IVA SILO HEADWORKS UNDER CONSTRUCTION
- IVB CLEARING AND EXCAVATION FOR CONTROL/GUIDANCE
- V SILO COMPLETE TO SURFACE LEVEL
- VIA INSTALLATION OF RAILS--LEVEL ACCESS ROAD PATTERN NOT WELL DEFINED
- VIB CONTROL/GUIDANCE UNDER CONSTRUCTION
- VII LEVEL ACCESS ROAD PATTERN WELL DEFINED
- VIII CONTROL/GUIDANCE COMPLETED
- IX LEVEL ACCESS ROAD COMPLETE, SURFACING OF ROAD AND INSTALLATION OF SILO DOOR
- X SITE COMPLETE

FIGURE 20

CONFIGURATION OF LAUNCH SILO AND SILO DOOR

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REFERENCES

Photography

See List of Illustrations

Documents

25X1	1.	CIA.	[redacted]	Construction Status of Soviet Single Silo ICBM Sites [redacted] (TOP SECRET [redacted])	25X1
25X1	2.	NPIC.	[redacted]	Possible Guidance-Associated Launch Sites and Geodetic Monuments at Type III-D Launch Sites [redacted] (TOP SECRET [redacted])	25X1
25X1	3.	NPIC.	[redacted]	Construction Techniques and Procedures Associated with the Type III-D ICBM Launch Silo [redacted] (TOP SECRET [redacted])	25X1
25X1	4.	CIA.	[redacted]	Analysis of Soviet Type III-D ICBM Sites [redacted] (TOP SECRET [redacted])	25X1

Requirement

C-RR6-84,075

IAS Project

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